Midterm Exam

CMSY-217, Spring 2011

Section 1. Answer True or False to each of the following statements:

_____ 1. A recursive Java method can be called by itself, called directly, or called indirectly through another method.

_____ 2. The `linearSearch` method in the `Arrays` class has a runtime efficiency of $O(1)$.

_____ 3. The `List` interface is a subinterface of the `Collection` interface.

_____ 4. The process by which the Java complier replaces generic type parameters and arguments within a class or method is called erasure.

_____ 5. The `Stack` class represents a first-in-first-out (FIFO) stack of objects.

_____ 6. The x-coordinate in Java is the horizontal distance moving right from the left side. The y-coordinate in Java is the vertical distance moving up from the bottom edge.

_____ 7. The Java Network Launch Protocol (JNLP) file is an XML document.

_____ 8. JPanels may have components, including other panels, added to them.

Section 2. Circle the letter of the best answer for each question:

9. In the JVM, the current method executing is always the method whose activation record is:
   (a) at the bottom of the runtime stack.
   (b) at the top of the runtime stack
   (c) never placed on the runtime stack.
   (d) second from the top of the runtime stack, just below the record for the previous method call.
10. What is the runtime efficiency of the Bubble Sort algorithm contained in the demo applets of the JDK?
   (a) $O(1)$
   (b) $O(n)$
   (c) $O(n \log n)$
   (d) $O(n^2)$

11. Which interface requires the `compareTo` method to be implemented?
    (a) `Comparable`
    (b) `Enumerable`
    (c) `Orderable`
    (d) `Tractable`
12. The Java keyword used to specify the upper bound of a generic class is:
    (a) `bounds`
    (b) `extends`
    (c) `implements`
    (d) `limits`
13. The `LinkedList` class can be used to implement which of the following custom data structures?
    (a) stack
    (b) queue
    (c) double-ended queue
    (d) all of the above
14. Which of the following is equivalent to the constant `Color.BLUE`?
    (a) `new Color(255,0,0);`
    (b) `new Color(0,255,0);`
    (c) `new Color(0,0,255);`
    (d) `new Color(255,255,0);`
15. Which method is *not* part of the applet life cycle?
    (a) `init`
    (b) `start`
    (c) `main`
    (d) `paint`
16. What Java IDE is often regarded as having the best integrated facility for GUI development?
    (a) BlueJ
    (b) Eclipse
    (c) NetBeans
    (d) Visual Studio

Section 3. Answer the following questions:

17. The factorial function can be defined recursively as:

$$n! = \begin{cases} 1 & \text{if } n = 0 \\ n \times (n-1)! & \text{if } n > 0 \end{cases}$$

Complete the recursive `factorial` method using this definition.

```
public static int factorial(int n)
{
   if (          )
   {



   }
   else
   {



   }
}
```

18. The selection sort algorithm makes $n - 1$ passes through an array of size n. On the first pass, it begins with the first element of the array and examines each successive element to determine the index of the smallest element; the first element and the smallest element are then swapped. On the second pass, it begins with the second element of the array and examines each successive element to determine the index of the smallest remaining element; the second element and the smallest remaining element are then swapped. The process repeats until the $n-1$ pass when the final two elements are examined and (possibly) swapped. Complete the `selectionSort` method below which uses the selection sort algorithm to sort an array of integers.

```
public static void selectionSort(int a[])
{
   int i, j, smallestIndex;

   for (                                  )
   {
      smallestIndex = i;
      for (                                  )
      {
         if (                          ) smallestIndex = j;
      }
      swap(a,i,smallestIndex);
   }
}
```

```
private static void swap(int a[], int i, int j)
{
   int temp = a[i];
   a[i] = a[j];
   a[j] = temp;
}
```

19. Provided that an instance of the `Stack<Character>` class called `stack` is in scope, write a method called `printReverse` that takes a `String` argument and uses `stack` to print its characters in reverse.

```
public static void printReverse(String s)
{
   for (                              )
   {



   }

   while(                          )
   {



   }

   System.out.println();
}
```

20. Write a self-referential, generic class called `Node` that has two `private` members - one which can store data of the parameterized type and another which is a link to the next node in the list.

21. You have implemented a custom generic list class that is doubly-linked. The references to the first and last nodes in the list are generic type parameters named `first` and `last`, respectively. Write a method called clear which removes all elements from the list.

```
public void clear()
{









}
```

22. Complete the `paint` method below so that running the program displays the message shown. Note that the font color is white, and the text is positioned at the coordinates $(40, 65)$.


```
public void paint(Graphics g)
{
   this.setBackground(Color.RED);
   this.setFont(new Font("Courier", Font.BOLD, 24));




   this.setSize(200,100);
}
```

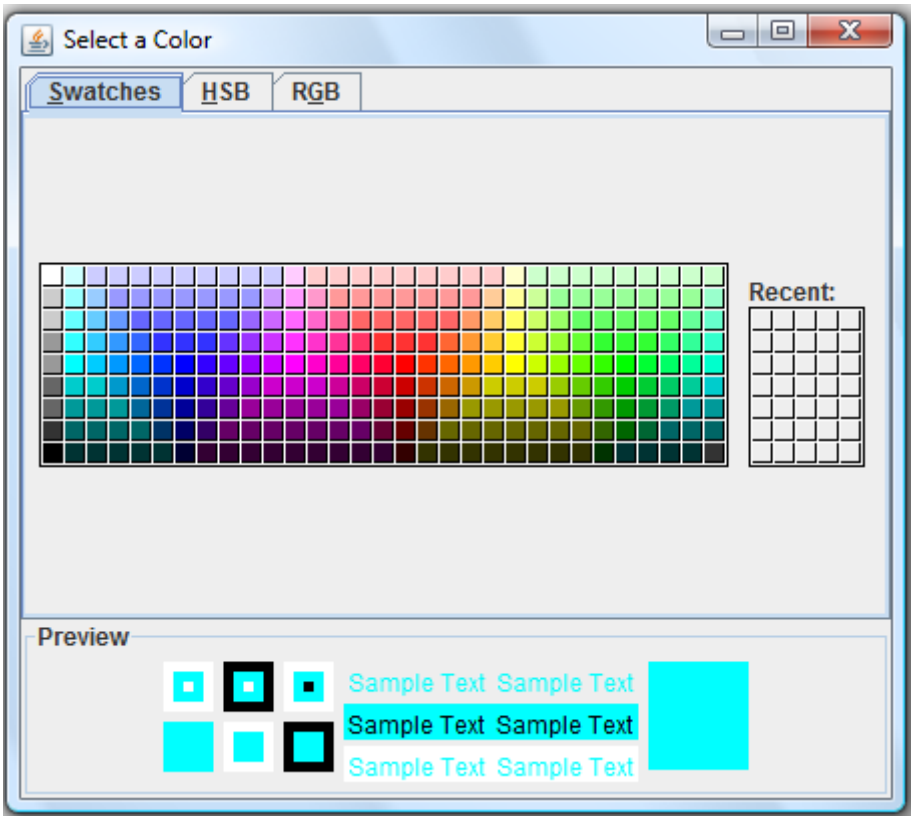
23. Write the applet tag for a class named `HelloWorldApplet` in the XHTML file below. Ensure that the applet display is 120 pixels wide and 50 pixels high.

```
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN"
 "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
<head>
<meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
<title>Hello World</title>
</head>
<body>



</body>
</html>
```

24. Complete the `main` method below so that running the program displays the following dialog box




```
public static void main(String args[])
{
   JFrame frame = new JFrame("Select a Color");



   frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
   frame.setSize(450, 400);
   frame.setVisible(true);
}
```

Section 4. Circle the letter of the best answer for each question:

25. Given the following method, what is the the return value for the method call `compute(8)`?

```
public static int compute(int n)
{
   if (n == 0)
      return 0;
   else if (n == 1)
      return 1;
   else
      return compute(n-1) + compute(n-2);
}
```

(a) 8

(b) 13

(c) 21

(d) 34

26. Suppose the array `[40, 17, 45, 82, 62, 32, 30, 44, 93, 10]` is passed to the method below to perform an insertion sort. What are the contents of the array after the first iteration of the `for` loop?

```
public static void insertionSort(int[] data)
{
   int insert;

   for (int next = 1; next < data.length; next++)
   {
      insert = data[next];

      int moveItem = next;

      while (moveItem > 0 && data[moveItem - 1] > insert)
      {
         data[moveItem] = data[moveItem - 1];
         moveItem--;
      }

      data[moveItem] = insert;
   }
}
```

(a) `[10, 17, 45, 82, 62, 32, 30, 44, 93, 40]`

(b) `[17, 40, 45, 82, 62, 32, 30, 44, 93, 10]`

(c) `[17, 40, 45, 62, 32, 30, 44, 82, 10, 93]`

(d) `[10, 17, 30, 32, 40, 44, 45, 62, 82, 10]`

27. Consider the following code segment.

```
ArrayList<String> list = new ArrayList<String>();

list.add("P");
list.add("Q");
list.add("R");
list.set(2, "s");
list.add(2, "T");
list.add("u");
System.out.println(list);
```

What is printed as a result of executing the code segment?

(a) `[P, Q, R, s, T]`

(b) `[P, Q, s, T, u]`

(c) `[P, Q, T, s, u]`

(d) `[P, T, Q, s, u]`

(e) `[P, T, s, R, u]`

28. What is the output if you compile and execute the following Java application?

```
import java.util.*;

public class FooSort
{
   public static void main(String args[])
   {
      Integer a[] = {3, 1, 4, 6, 5, 2, 0};
      fooSort(a);
      System.out.println(Arrays.toString(a));
   }

   public static <E> void fooSort(E[] a)
   {
      Arrays.sort(a);
   }

   public static void fooSort(Integer[] a)
   {
      Arrays.sort(a, Collections.reverseOrder());
   }
}
```

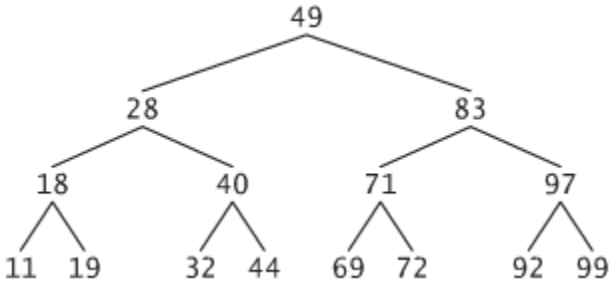
(a) `[Ljava.lang.Integer;@3e25a5`

(b) `[0, 1, 2, 3, 4, 5, 6]`

(c) `[6, 5, 4, 3, 2, 1, 0]`

(d) Compilation fails.

29. A binary search tree is constructed using a generic self-referential tree node class. Fifteen nodes are added and the tree can be represented visually by the following figure



If the following recursive method is called on the root node of the tree, what is the output?

```
public static <E> void traverse(TreeNode<E> node)
{
   if (node.getLeft() != null) traverse(node.getLeft());
   System.out.print(node.getData() + " ");
   if (node.getRight() != null) traverse(node.getRight());
}
```

(a) `49 28 18 11 19 40 32 44 83 71 69 72 97 92 99`

(b) `11 18 19 28 32 40 44 49 69 71 72 83 92 97 99`

(c) `11 19 18 32 44 40 28 69 72 71 92 99 97 83 49`

(d) `49 28 83 18 40 71 97 11 19 32 44 69 72 92 99`

30. What is the output when the following `main` method is compiled and run?

```
public static void main(String args[])
{
   Integer a[] = {3, 1, 4, 1, 5, 9, 2};
   List<Integer> l = Arrays.asList(a);
   l.remove(2);
   System.out.println(Arrays.toString(a));
}
```

(a) `[3, 1, 4, 1, 5, 9]`

(b) `[3, 1, 1, 5, 9, 2]`

(c) Compilation fails.

(d) An exception is thrown at runtime.

31. You have written an applet called `LoanCalculator` which is invoked by an applet tag in an XHTML file named LoanCalculator.html. What is the correct command to test your applet with the appletviewer program from the JDK.

    (a) `appletviewer LoanCalculator`

    (b) `appletviewer LoanCalculator.class`

    (c) `appletviewer LoanCalculator.html`

    (d) `appletviewer LoanCalculator.java`

32. What interface should be implemented when a specific action is to take place when the user clicks on a `JButton`?

    (a) `ActionEvent`

    (b) `ActionListener`

    (c) `ActionPerformed`

    (d) `ActionTaker`

Section 5. Fill in the blanks in each of the following statements:

33. When implementing a Java program program to compute factorials, the precision of the `int` and `long` types was exceeded at 12! and 21!, respectively. In order to compute larger factorials, one may use the _____ or _____ class from the `java.math` package.

34. The two recursive sorting algorithms that we studied and implemented in Java were the _____ and _____ .

35. Although the classes of the Java Collections Framework can only be used to store reference type objects, Java can automatically convert primitive-values to type-wrapper objects using _____ and convert from type-wrapper objects to primitive-type values using _____.

36. _____ and _____ enable you to specify a set of related methods or classes with a single declaration.

37. Since the stack data structure is a constrained version of a linked list, stacks may be implemented using classes that implement the `List<T>` interface such as the _____ or _____.

38. The `Graphics` class provides a method to display text called_____ and a method to display solid boxes called _____.

39. _____ and the _____ enable you to package your applets and applications so that they may be installed onto the user's desktop.

40. When writing a GUI application, you often need to import classes from the java._____ and the javax._____ packages.